Plankton Wars

Southeast Phytoplankton Monitoring Network (SEPMN)

Grades: 6-12

Subjects: Biology, Math, Geometry, Physics, Latin

Length of Lesson: 1-2 days science/math collaboration

Goals:

- To understand adaptation by demonstrating how plankton use structures and surface area to stay afloat in the photic zone
- To understand micron, a metric unit of measurement, and how mathematics (surface area) play a role in plankton survival

Objectives:

- Students will define and discuss adaptation
- Students will discuss photic zones
- Students will lean about plankton
- Students will create hypotheses based on which plankton will stay afloat the longest
- Students will determine the surface area and volume of their plankton
- Students will create a new species using arts and crafts materials
- Students will name their new species using the binomial system of taxonomy

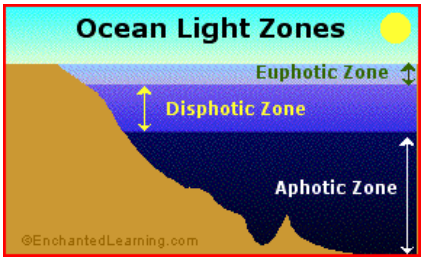
Standards:

Structure and Function of Fungi & Plants, Adaptations, Diversity, Observation, Inferences, Spatial Reasoning & Analysis, Predictions, Biological Classification, Communication, Creation of Scientific Models, Measurements, Scientific Inquiry, Photosynthesis, Technological Design, Analyze 2- and 3-D Dimensional Shapes, Geometric Modeling, Motions and Forces of Objects, Transfer of Light Energy

Materials:

- Small zip-lock bags
- Play-dough or clay cut into 1 inch cubes
- Pipe cleaners, straws, and/or colored toothpicks
- Ribbon and/or colored string
- Dried beans (any kind), dyed red for eye spots and green for chloroplasts; small pom pons (found in craft supply stores); and/or extra clay or play-dough
- Aluminum foil
- Large clear plastic container to hold water
- Other craft supplies you have available
- Stop watch
- Meter stick
- Metric ruler for each group
- Calculators for each group (optional)
- Plankton Wars worksheet
- Plankton ID Key
- English-Latin Key
- Formula sheets

Background:



Photic Zone:

Most living things in the ocean are found in the narrow portion near the surface called the photic zone or the euphotic zone (euphotic is the Greek term for "well lit"). The photic zone is the surface layer of the ocean that gets sunlight, where photosynthesis takes place. Most of the animals in the ocean live in the sunlit (photic) zone or migrate to it in search of food. Nearly all marine life depends directly or indirectly on microscopic algae, called phytoplankton found at the ocean surface.

Phytoplankton:

Phytoplankton are special and unique organisms that play a vital role in our environment. *Phyto-* comes from a Greek word that means plant. *Plankton,* another Greek word, means wandering or drifting. The definition of phytoplankton is drifting or wandering plants.

These organisms are single-celled and normally microscopic (less than 100 microns in diameter).

Like land plants, phytoplankton utilize photosynthesis to produce their own food and energy. Unlike land plants, phytoplankton do not have true roots, stems, and leaves but have other adaptations that assist them in surviving in the environment. Phytoplankton have developed pores, spines, processes (projections), flagella, and eye spots. The functions of these characteristics are to increase the surface area of the plant to decrease sinking rate, facilitate absorption of nutrients, and increase exposure to sunlight for photosynthesis.

Some phytoplankton have developed structures that contain vacuoles or cavities that contain water, air, or oils to aid in floatation near the water's surface. Finally, the shape of the cell is also an adaptation of phytoplankton. Some cell shapes includes rods, ribbons, chains, discs, spheres, leaf-like, and many more.

Zooplankton are the animal plankton. They feed on phytoplankton and each other. There are 2 different types of zooplankton: *holoplankton* (remain in the plankton stage for their entire life) and *meroplankton* (larval stage or beginning stages of life). Meroplankton will later develop into a crab, shellfish, shrimp or worm. Zooplankton also have several adaptations to help them stay in the photic zone. Many zooplankton have long appendages with attached hairs to not only grab prey but to also assist in buoyancy and increase surface area. These plankton also have the ablitiy to store fats and oils in their bodies to help keep them buoyant.

Surface Area to Volume Ratios:
Surface area to volume ratios are very important to the sinking rate and nutrient uptake of phytoplankton. Smaller cells will have larger surface area to volume ratios. In nutrient poor waters, a smaller cell would have a competitive advantage since this cell would be able to take up nutrients faster than a large cell. The rate of nutrient absorption is proportional (equal) to the cell's surface area. However, when nutrients are not limited, larger cells with a larger volume would be favored.

Micrometer: When we look at things under the microscope, we use a metric unit of measurement called micrometers or *microns* (µm). It takes 1000 µm to equal one millimeter. One micron equals 0.001 millimeter. Most phytoplankton are smaller than 100µm.

Procedures:

Preparation before Classroom session:

1. We recommend partnering with a math, geometry, or physics teacher to conduct this lesson plan. This two-part lesson is design to be used across the curriculum so that students can develop an understanding that math and biology are interconnected and occurs naturally in the environment. Phytoplankton are a great way to illustrate that math and geometry have a very specific purpose in its life cycle; plankton utilizes surface area for its survival.
2. Before the start of this lesson, assign students homework and instruct them to learn about phytoplankton via online resources. There are many scientific and educational web sites that focus on phytoplankton, including SEPMN. (http://www.chbr.noaa.gov/pmn/
3. Part I of this lesson: The biology teacher discusses in class: phytoplankton, ocean zones, and adaptations. The math teacher discusses surface area, volume, geometric shapes, metric measurements, and rate of travel.
4. Part II of this lesson: Students will create their plankton. They will also measure, name, and race their plankton.
5. Teachers should pre-make the bags of art supplies for the students before conducting part two of this lesson (Instructions are found in Part II of Lesson Plan).

6. Prepare the materials for each group by using the arts & crafts materials from the list provided in this lesson.
7. For this lesson, you will divide the class into an even number of groups. Keep the groups relatively small (about 3-5 students per group).
8. Make 1 bag of materials for each group; however, for every bag you make, you should make a second one with the same materials. (Each set of two bags will have the same materials). For example, 2 bags will each contain a piece of clay, 2 pieces of string or ribbon (lenth about 2-3 inches) to make flagella, pom pons, dried beans, or extra clay or play-dough for eye spots, pores, and chloroplasts or other organelles. Another set of 2 bags may contain a piece of clay for the main body, foil to represent cell housing, toothpicks, straws, or small pieces of pipe cleaners for spines and processes, beans pom pons, or clay for pores, eye spots, and other organelles. Another set of 2 bags can contain materials to make zooplankton.
9. Even though every group will make their plankton different, two groups will use the same materials. These two groups will the same materials will compete in the plankton war. The goal is to illustrate that even though the same materials were used, the students' newly created plankton adapted differently to their environment.
10. Label each set of bags 1a and 1b, 2a and 2b, etc… Each set of bags have the same materials but differs from the other sets in the types of materials they contain.

Part I of Lesson Plan:
Introduction

1. Ask the students questions:
   - What are plankton?
   - Where do plankton live and why?
   - What are some types of plankton?
   - Why are they important?
2. Pass out the color ID key of various plankton
3. Discuss different adaptations that plankton use to stay in the photic zone
4. Discuss surface area, volume, metric measurements, geometric shapes, and rate of travel

Part II of Lesson Plan:
Creating the Plankton

1. Tell students that they will be creating their own plankton and measuring surface area and volume.
2. Remind the students that their plankton are going to battle for survival in the photic zone.
3. Divide the students into an even number of groups (6, 8 or 10 groups). Keep the groups relatively small (about 3-5 students per group).
4. The students' objective is to create their plankton so that it will stay in the photic zone for the longest period of time. The plankton can stay afloat at the surface, but must eventually be submerged. If it were to stay afloat at the surface, it would dry up and die from the sun.
5. Allow the students to brain storm the types of structures that are found in plankton. Phytoplankton: frustule (cell housing made of silica or glass in diatoms), pores, processes, spines, chains, flagella, eye spot, theca (cell housing made of cellulose in dinoflagellates), nucleus, chloroplasts, mitochondria, Golgi apparatus, and other cell organelles. Zooplankton: eyes, appendages, tails, cilia, mouth, nematocysts, digestive cavity, shells made of calcium carbonate, protoplasm, and antennae.
6. Your photic zone will be a large, clear plastic container filled with water.
7. Give each group a bag of materials. Each group must use all the materials in the bag when they create their plankton.
8. When the students finish creating their plankton, they will use the English-Latin key to choose a Genus and species name for their organism. The name can be based on color, structure, function, size, habitat,

location found, and the name of the person(s) who discovered the species.

Measuring Surface area and Volume

1. After they have created their new species, the students will measure their plankton to find length, width, and height of the main body. (Optional: students can also measure the adaptations such as process, spines, and flagella.)
2. Record all measurements in millimeters on the Plankton Wars worksheet.
3. For homework or in math class, the students can find the surface area, volume, and rate of sinking for their plankton. Each student will also convert all measurements from millimeters to microns.

Plankton Wars

1. Assign a student to be the timer keeper. If the photic zone is large enough, allow the groups with identical materials race against each other at the same time.
2. Allow the two groups with identical materials come to the front of the room to prepare their plankton for battle.
3. One student from each group will be the representative and will describe the name, adaptations, structure and habitat of the plankton.
4. Before each paired plankton battle, the class will vote to choose who they think will win. Write a hypothesis on the board of why they think it will float the longest.
5. Record the depth of the tank and the sinking times for each group.
6. Declare the slowest one the winner. Remind them that if their plankton does not sink, it will be disqualified. Why? If the plankton stays directly on the surface, the sun will dry the organism, causing it to die.

Extensions

1. Repeat Plankton Battle with the winners from the first round.
2. Allow the students to figure out the average time and the sinking rates from the winning groups.
3. Record the winning time, surface area and volume.
4. Record the conclusions and give reasons why they think the winning plankton stayed in the photic zone the longest.
5. You can also use different temperatures and salinities of water to see if it makes an impact on float time.
6. Graph or chart the classroom results
7. Students can develop a bulletin board illustrating what they learned with photos, drawings, charts and graphs, and shadow boxes containing the different plankton created by the students.

Observations:

1. What are plankton?
2. Why are plankton important?
3. What is it about plankton that makes them unique?
4. How does surface area help plankton?

Conclusions:

The students should be able to explain the different types of plankton, what plankton do and why they are important. Despite their small size, plankton and other marine plants have unique adaptations that aid in their survival. Marine plankton also have large surface areas and small volumes; these ratios allow for better nutrient absorption, facilitate photosynthesis, and decrease sinking rate.

References:

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Credit: This activity was originally created by MARE (Marine Activities, Resources & Education) in the Open Ocean Curricula for the 5th grade level, called the Great Plankton Race.

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Contact Information:

For questions about this lesson plan or information about our program, please contact the staff at the Southeast Phytoplankton Monitoring Network (SEPMN).

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